

Marine productivity variations and environmental perturbations across the Early Triassic Smithian-Spathian boundary: insights from zinc and carbon isotopes

XIANGDONG WANG¹, LAISHI ZHAO¹, PETER A. CAWOOD², THOMAS J. ALGEO³, ZHONG-QIANG CHEN¹, LEI ZHANG¹, ZHENGYI LYU¹

¹ University of Geosciences (Wuhan), Wuhan 430074, China

² Monash University, Victoria 3800, Australia

³ University of Cincinnati, Cincinnati, OH 45221, USA

The biotic recovery following the end Permian mass extinction (EPME) was unstable with repeated environmental crises, each of which was followed by a comparably more hospitable interval for life. The early Triassic Smithian-Spathian boundary (SSB) event represents a conspicuous turnover in the environment, climate, and biotic communities. To explore the causes and consequences of this event we have determined zinc and carbon isotopes along with elemental paleoenvironment proxies through the West Pingdingshan section, Chaohu, South China. An abrupt decrease of $\delta^{66}\text{Zn}$ values, along with the highly negative $\delta^{13}\text{C}$ values occur in the latest Smithian at Beds 47–50 of the section, are coincident with the bio-crisis, and are ascribed to weak marine productivity and extremely hot climatic conditions. Rapid positive shifts in $\delta^{13}\text{C}_{\text{org}}$ and $\delta^{13}\text{C}_{\text{carb}}$ values and high contents of TOC at Beds 51–52, demonstrate elevated marine productivity associated with a surface seawater cooling event, but also resulted in oxygen-starved conditions lethal to organisms. Marine and terrestrial ecosystems recovered in the early Spathian in Beds 53–57, as evidenced by high values of $\delta^{66}\text{Zn}$, $\delta^{13}\text{C}$ and the absence of framboid pyrite, and low Al content, which indicate a return to normal marine productivity and oxygenated seawater, and decreased terrestrial sediment input. Our findings provide possible mechanisms for affecting the marine Zn cycling across the SSB and clarify the causes and consequences of the SSB event.